

Nov. 20, 1934.

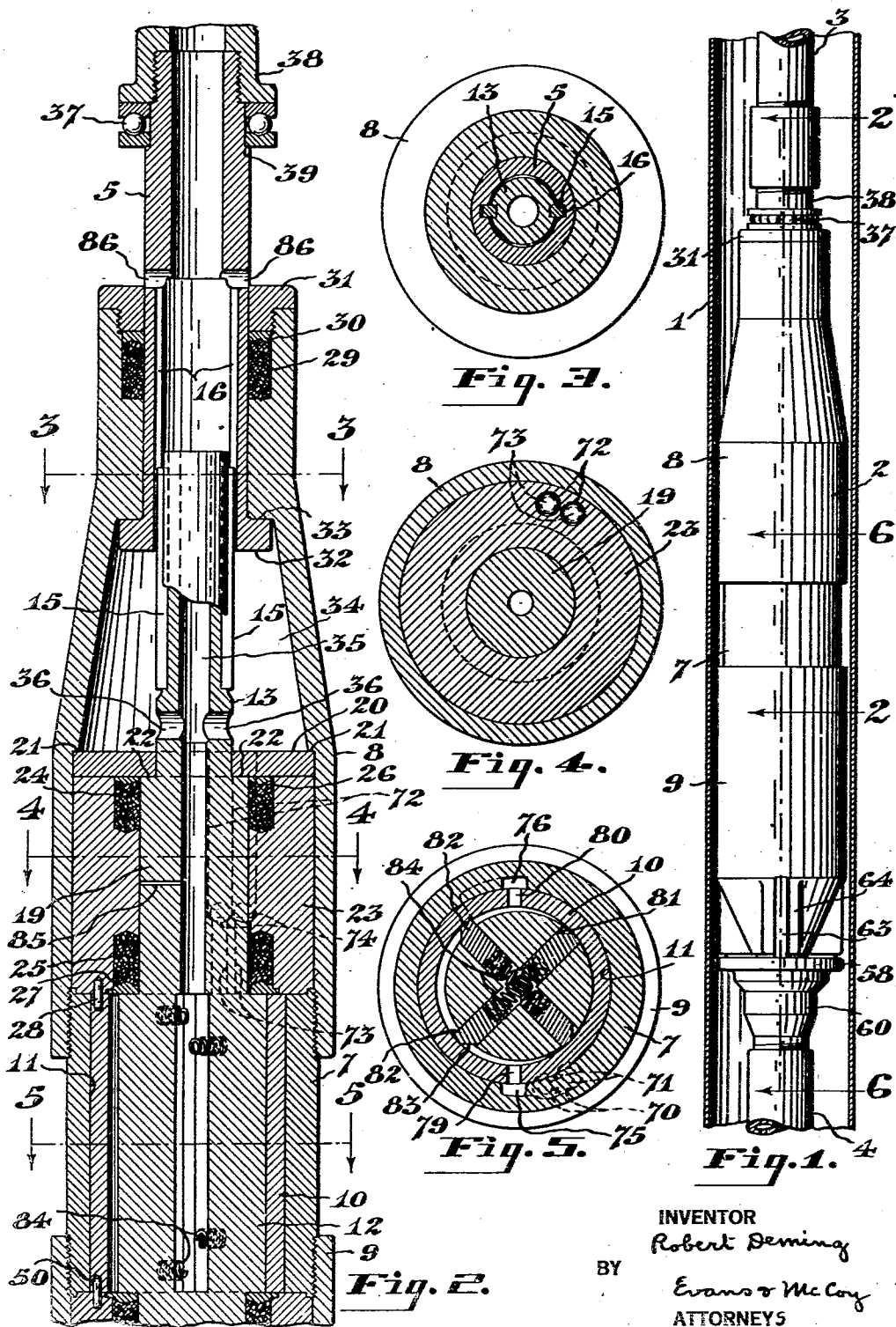
R. DEMING

1,980,986

PUMPING APPARATUS

Filed Oct. 10, 1930

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

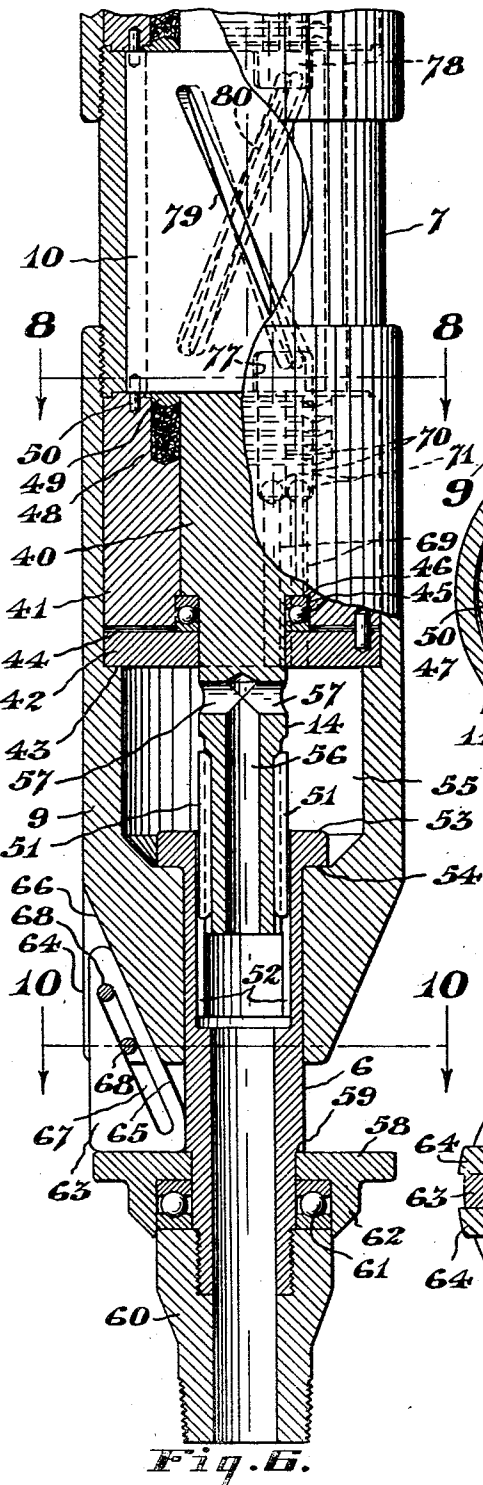


Fig. 7.

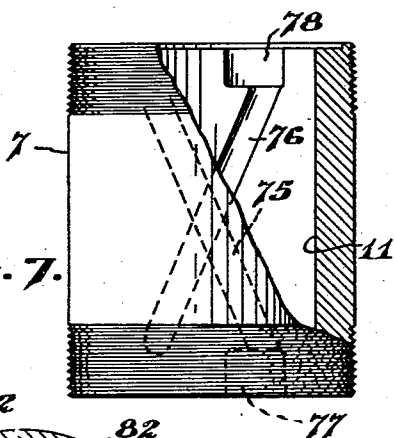
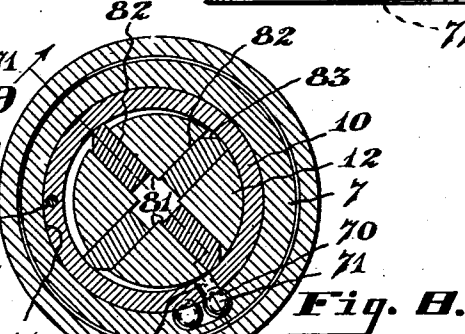
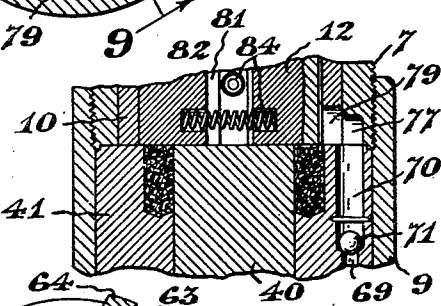
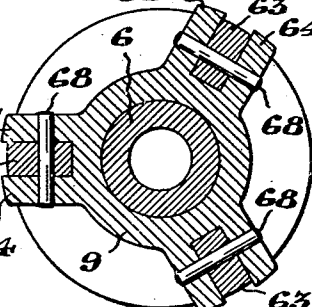


Fig. 10.

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1,980,986

PUMPING APPARATUS

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10 Claims. (Cl. 103—119)

This invention relates to pumping apparatus and more particularly to pumping apparatus suitable for elevating liquids and discharging the same from bored wells in which a plurality of rotary piston pumps are connected at spaced intervals in the line of tubing extending down into the well and are adapted to be operated by rotating the tubing.

The present invention is an improvement on the apparatus disclosed in my copending application Serial No. 419,809, filed January 10, 1930 for Well pumps, in which a number of rotary piston pumps are joined into a line of tubing extending down into a well and are adapted to be operated to pump liquid through the tubing by rotating the tubing, each pump housing being provided with means by which it is automatically anchored in the well and held against rotation.

One of the objects of the present invention is to provide a pump in which the leakage past the bearings of the pump rotor and between the body of the rotor and the pump housing is reduced to a minimum.

A further object is to provide a pump of the rotary positive pressure type in which the inlet and outlet ports of the rotor chamber are sealed, one from the other, wholly by the vanes of the rotor independently of the body of the rotor.

A further object is to provide a pump capable of discharging the full volume of liquid drawn into the pump casing during each revolution without creating back pressure.

A further object is to provide a pump in which the pressure of the liquid being pumped is utilized to press the vanes of the rotor outwardly against the wall of the rotor chamber.

A further object is to provide means for effectively lubricating the bearings of the pump.

A further object is to provide a connection between the tubing extending upwardly from the pump housing to which the rotor of the pump is keyed and the pump housing which permits a relative longitudinal movement so that the tubing may be lowered and raised to exert a jarring impact on the housing to free the housing from the well wall and facilitate removal of the tubing and pump housing from the well.

A further object is to provide means for automatically draining the liquid from the well tubing when the tubing is lifted to withdraw the tubing and pumps from the well.

With the above and other objects in view, the invention may be said to comprise the device as illustrated in the accompanying drawings hereinafter described and particularly set forth in the

appended claims, together with such variations and modifications thereof as will be apparent to one skilled in the art to which the invention appertains.

Reference should be had to the accompanying drawings forming a part of this specification in which:

Figure 1 is a fragmentary sectional view showing a pump housing and portions of the well tubing above and below the same positioned within a well casing.

Fig. 2 is a fragmentary section on an enlarged scale taken axially through the pump housing.

Fig. 3 is a section taken on the line indicated at 3—3 in Fig. 2.

Fig. 4 is a section taken on the line indicated at 4—4 in Fig. 2.

Fig. 5 is a section taken on the line indicated at 5—5 in Fig. 2.

Fig. 6 is an axial section through the lower portion of the pump housing.

Fig. 7 is a detail view showing the sleeve forming a wall of the rotor chamber.

Fig. 8 is a section taken on the line indicated at 8—8 in Fig. 6.

Fig. 9 is a section taken on the line indicated at 9—9 in Fig. 8.

Fig. 10 is a section taken on the line indicated at 10—10 in Fig. 6.

Figure 1 of the drawings shows a pump embodying the present invention, mounted within a well casing 1, the pump having a housing 2 of an external diameter enough less than that of the well to permit it to be freely lowered into the well. Portions of the well tubing through which the liquid is pumped are shown at 3 and 4 above and below the pump housing, the tubing sections 3 and 4 being coupled to tubular members 5 and 6 which extend into the ends of the housing 2 and which have a sliding and rotating fit in the ends of the housing 2. The housing 2 consists of a central cylindrical section 7, which is externally threaded at its ends, and upper and lower end sections 8 and 9 which are internally threaded and screwed onto the opposite ends of the central section 7. A cylindrical sleeve 10 fits within the cylindrical housing member 7 which has an internal bore 11 eccentrically disposed with respect to the exterior cylindrical surface thereof, the sleeve 10 having a press fit within the housing member 7 and forming a wall of the rotor chamber of the pump.

A rotor 12 is mounted within the sleeve 10 concentrically with the housing, but eccentrically with respect to the cylindrical wall formed by the

sleeve 10, the rotor 12 having upper and lower axial stepped extensions 13 and 14 formed integrally therewith, providing bearing shafts for the rotor. The upper extension 13 has longitudinally extending keys 15 secured in longitudinal exterior grooves extending downwardly from the upper ends thereof and slidably fitting in longitudinal grooves 16 formed upon the interior of the tubular member 5 which extends through the upper end of the housing 2. The tubular member 5 is coupled to the well tubing above the pump so that the well tubing, which may be rotated by a suitable mechanism at the top of the well, together with the tubular section 5 forms a driving shaft for imparting rotation to the pump rotor.

As shown in Fig. 2 of the drawings, the upper extension 13 of the rotor 12 has a bearing portion 19 of greater diameter than the upper end portion of the extension and of somewhat less diameter than the body portion of the rotor within the pump chamber. The rotor is positioned with respect to the upper section 8 of the pump housing by means of a thrust member in the form of a disc 20 which fits within the lower portion of the section 8 and is seated against an internal shoulder 21 formed in the housing section and engaging the top of the disc. The disc 20 has a central opening in which the upper portion of the axial extension 13 of the rotor fits and the under face of the disc at the margin of the central opening seats on a shoulder 22 at the upper end of the bearing portion 19 of the rotor extension.

The bearing portion 19 of the rotor extension is journaled in a bearing sleeve 23 which fits within the upper section 8 of the pump housing below the disc 20 and which is clamped between the central housing section 7 and sleeve 10 and the disc 20. In order to prevent leakage of liquid between the sleeve 23 and the bearing portion 19 of the rotor extension, the sleeve 23 is counterbored at its upper and lower ends to provide spaces to receive packings 24 and 25. The packings 24 and 25 are preferably composed of rings of packing material which are V-shaped in radial section, so that they will be expanded laterally into tight engagement with the bearing portion 19 of the rotor when endwise pressure is exerted on the packings. The upper packing is provided with a follower ring 26 which is engaged by the under face of the disc 20 and the lower packing is provided with a follower ring 27 which is engaged by the rotor 12 and the upper end of the sleeve 10, so that when the sleeve 19 is tightly clamped between the disc 20 and the central section 7 of the pump housing, the follower rings 26 and 27 will be pressed against the packings to expand the same and provide an effective seal.

The sleeve 23 is held against turning movement within the pump housing by means of one or more pins 28 fitting in registering holes bored in the lower end of the sleeve 23 and the upper end of the sleeve 10.

To prevent leakage between the tubular member 5 and the upper end of the pump housing, within which the tubular member has sliding and rotating engagement, a packing 29 is disposed in the upper end of the housing around the tubular member 5, this packing being an expansible packing of the type employed around the bearing portion 19 of the rotor, and being compressed and expanded against the exterior surface of the tubular member 5 by means of a follower 30 held in place by a gland nut 31.

The tubular member 5 has an outwardly projecting flange 32 at its lower end which engages

an internal shoulder 33 formed in the upper end portion of the pump housing, the flange 32 serving to support the pump housing as the same is being lowered into the well.

The internal shoulder 33 of the upper section 8 of the pump housing is spaced a sufficient distance above the shoulder 21 against which the disc 20 is seated to provide a chamber 34 which serves as the outlet chamber of the pump. The axial extension 13 of the pump rotor is provided with an axial bore 35 extending from the upper end thereof and this bore communicates with the chamber 34 through lateral openings 36, so that liquid may pass from the chamber 34 into the bore 35 and thence to the tubing above the pump housing.

The tubular member 5 has a ball thrust bearing 37 clamped thereon between a coupling member 38 and a shoulder 39 on the tubular member. When the pump and tubing is being lowered into the well, the pump housing is supported on the flange 32 of the member 5 and after the pump has been lowered to its final position in the well, the tubular member 5 is lowered into the pump housing until the thrust bearing 37 rests upon the gland nut 31 at the upper end of the pump housing and the tubing extending upwardly from the pump housing is then supported on the thrust bearing 37.

As shown in Fig. 6 of the drawings, the lower extension 14 of the pump rotor has a bearing portion 40 of larger diameter than the lower end portion of the extension and of less diameter than the body of the rotor. The bearing portion 40 is journaled in a sleeve 41 which fits within the upper portion of the lower section 9 of the pump housing, the sleeve 41 being clamped between the lower end of the central section 7 of the pump housing and a thrust member in the form of a disc 42 seated on an internal shoulder 43 formed on the interior of the section 9. The disc 42 has a central opening of a size to fit over the lower end portion of the extension 14 of the pump rotor and suitable shims 44 may be interposed between the discs 42 and the lower end of the sleeve 41 to take up any end play between the rotor and the thrust members. The disc 42 supports the rotor and to reduce the frictional resistance to rotation, a ball thrust bearing 45 is interposed between the upper face of the disc 42 and a shoulder 46 at the lower end of the bearing portion 40 of the rotor.

The sleeve 41 and disc 42 are held against relative turning movement by means of one or more pins 47 engaging in registering openings bored in the disc 42 and the lower end of the sleeve 41. The upper end of the sleeve 41 is counterbored to receive a packing 48 of the same type employed in the upper bearing of the rotor and this packing is engaged by a follower 49 which is engaged by the lower end of the sleeve 10 and the rotor 12. One or more pins 50 are interposed between the lower end of the sleeve 10 and the upper end of the sleeve 41 to hold the sleeves against relative turning movement.

The lower rotor extension 14 is provided with keys 51 mounted in external longitudinal grooves thereon which engage in longitudinal grooves 52 formed in the lower tubular member 6 which projects through the lower end of the pump housing, so that a driving connection is provided between the rotor and the tubing extending downwardly from the pump.

The upper end of the tubular member 6 is provided with an outwardly projecting flange 53 which engages an internal shoulder 54 in the lower

end portion of the lower section 9 of the pump housing. The internal shoulder 54 of the section 9 is positioned a sufficient distance below the shoulder 43 to provide a chamber 55 which serves as the inlet chamber of the pump. The extension 14 has an axial bore 56 extending from its lower end and this bore communicates with the chamber 55 through lateral openings 57 adjacent the under side of the plate 42 and adjacent the upper end of the bore 56, so that liquid may pass upwardly from the tubing below the pump into the inlet chamber.

Below the lower end of the pump housing, a seating collar 58 is secured upon the tubular member 6 being clamped between a shoulder 59 on the tubular member 6 and a coupling member 60 at the lower end of the tubular member which serves to connect the tubular member to the well tubing below the pump, a ball thrust bearing 61 being interposed between the seating collar 58 and the coupling member 60 to reduce the frictional resistance to rotation of the well tubing when the pump housing is supported upon the tubing below the same. The thrust bearing 61 is preferably covered by an annular flange 62 formed integrally with the collar 58 and extending downwardly therefrom.

As disclosed in my copending application above referred to, a series of pumps may be connected at suitable intervals along the length of the well tubing extending down into the well, and means is provided in connection with each pump housing for anchoring the same to the wall of the well so as to hold the housing against rotation. The anchoring means, as herein shown, consists of a number of wedge shaped plates 63 which are mounted between flanges 64 formed integrally with the housing section 9 and are supported on the seating collar 58, said plates having inclined inner edges 65 which engage with downwardly tapering side faces 66 of the lower housing member 9.

The wedge plates 63 are provided with elongated slots 67 which are parallel with the inner inclined edges 65 thereof and receive pins 68 secured to the flanges 64. As the tubing is being lowered into the well, the tubing below the pump housing is supported by the flange 53 of the tubular member 6 and the seating collar 58 is at a distance below the lower end of the housing such that the wedge plates 63 are held in retracted position, until the tubing is brought to a stop by engagement with the bottom of the well or with a pump housing which has been anchored, whereupon the pump housing moves down on the tubular member 6, crowding the wedges 63 out against the wall of the well and anchoring the pump housing against rotation.

In introducing the well tubing and pumps into the well, the tubing sections are joined end to end in the usual manner and a pump housing is joined by means of the coupling member 60 to the upper end of a tubing section and is lowered into the top of the well, another section of the well tubing being then joined to the upper end of the tubular member 5 at the upper end of the housing, by means of the coupling member 38 in the same way that successive sections of tubing are joined as the tubing is being lowered into a well.

To establish communication between the pump chamber and the inlet chamber 55, a plurality of parallel longitudinally extending bores 69 extend upwardly through the supporting disc 42 and the bearing sleeve 41 and communicate at their upper end with axially aligned bores 70 of somewhat larger

diameter which extend downwardly from the upper end of the sleeve 41. The bores 70 of larger diameter provide chambers to receive balls 71 which provide check valves in the passages to prevent leakage of liquid from the rotor chamber.

Communication is established between the outlet chamber 34 and the pump chamber through a plurality of bores 72 which extend downwardly through the disc 20 and the bearing sleeve 23 and communicate at their lower ends with axially aligned bores 73 of smaller diameter, balls 74 being positioned in the bottoms of the bores 72 to close the upper ends of the bores 73 and provide check valves at the outlet of the pump to prevent liquid which has been delivered from the rotor chamber from leaking back into the chamber.

As shown in Figs. 5 and 7 of the drawings, the interior face of the central section 7 of the pump housing is provided with helically extending grooves 75 and 76 which as shown in the accompanying drawings may be diametrically opposite and which provide passages for liquid to the rotor chamber. The groove 75 has an enlarged lower end 77 which registers with the upper ends of the bores 70 and the groove 76 has an enlarged upper end 78 which registers with the lower end of the bores 73. The sleeve 10 is provided with helical slots 79 and 80 which terminate near the top and bottom of the sleeve and which register with the grooves 75 and 76 of the housing member 7.

As illustrated in Figs. 6 and 7, the grooves 75 and 76 and slots 79 and 80 are diametrically opposite each other and oppositely inclined, each groove and slot extending through somewhat less than 90 degrees circumferentially of the pump casing. The body portion of the rotor 12, which is disposed within the eccentric sleeve 10, is provided throughout its length with equiangularly disposed radial slots 81, the slots 81 preferably being diametrical slots extending entirely through the body of the rotor. In each of the slots 81, there are mounted two vanes or pistons 82 which are adapted to project beyond the periphery of the rotor at opposite sides thereof and engage with the wall of the pump chamber, the vanes 82 being pressed outwardly toward the wall of the pump chamber by means of springs 84 interposed between the two vanes of each of the diametrical slots 81. The slots 79 and 80 forming the inlet ports of the pump are shown arranged diametrically opposite each other at substantially equal distances on opposite sides of the portion of the eccentric chamber wall which is closest to the periphery of the rotor 12.

Since the ends of the inlet and outlet ports are spaced somewhat more than the angular distance between the slots 81, one of the vanes 82 will always move past the inlet port before the vane 82 in front of it begins to open the outlet port, and likewise, one of the vanes will have moved past the outlet port before the vane in front of it reaches the inlet port. Thus while liquid is discharging from one of the peripheral chambers of the rotor, liquid will be entering the diametrically opposite rotor chamber and the chamber from which liquid is discharging and the chamber into which liquid is entering will always be sealed from each other by one or more vanes of the rotor, so that the sealing between the inlet and outlet ports is accomplished solely by the vanes of the rotor and the body of the rotor need not have fluid tight engagement with the wall of the rotor chamber.

A serious difficulty encountered in the use of a

rotor piston pump in a well is the rapid wear of the rotor parts due to the abrasive action of sand contained in the liquid. In the pump of the present invention, the efficiency of the pump is not seriously impaired by abrasive action of sand passing through the pump since the movable vanes seal the spaces between the inlet and outlet ports on both sides of the pump chamber and wear on the ends of the vanes does not appreciably affect the sealing action.

The bore 35 of the upper extension 13 of the rotor extends down through the bearing portions 19 thereof and communicates at its lower end with the slots 81 in the body of the rotor, so that after the pump is started in operation, the vanes 82 will be subjected to the hydrostatic pressure existing at the pump outlet and will be pressed outwardly against the wall of the pump casing by the pressure of the liquid.

As clearly shown in Fig. 5 of the drawings peripheral chambers are formed between the exterior of the rotor body and the wall of the eccentric pump chamber by successive vanes 82 and these chambers increase in capacity as the vanes move past the inlet openings 79 and gradually decrease in capacity as the vanes move past the outlet opening 80 so that a suction is created at the inlet opening and a pressure developed at the outlet opening expelling the liquid from the pump chamber through the outlet passages into the pump chamber 34 and upwardly into the well tubing above the pump. By providing elongated helically disposed inlet and outlet openings 79 and 80, the peripheral chambers of the rotor communicate with the inlet passages while the volumetric capacity of the chambers is increasing and with the outlet passages while the volumetric capacity thereof is decreasing, so that a full charge of liquid may be trapped between the vanes of the rotor and each charge will be substantially completely discharged from the pump casing, as the vanes move past the outlet opening.

In the operation of the pump, a body of gas is trapped in the outlet chamber 34 above the port 36, and this gas which consists of air and other gases which may be present in the liquid being pumped provides an air cushion which prevents sudden variations in pressure in the outlet conduit absorbing the shock of pressure impulses and preventing any hammering action in the conduit.

By utilizing the pressure of the liquid to force the vanes of the pump outwardly against the cylindrical wall of the pump casing, an effective engagement of the vanes with the wall of the casing is insured at all times, regardless of the wear on the vanes and the pressure on the vanes is continuous and commensurate with the working head.

The upper bearing of the rotor is preferably lubricated by the liquid being pumped, the bearing portion 19 of the rotor extension being provided with a lateral passage 85 extending outwardly from the bore 35 to deliver the liquid to the interior of the bearing sleeve 23.

By providing a telescopic connection between the pump housing and the upper tubular member 5, play is provided between the pump housing and the well tubing extending upwardly therefrom to permit a jarring action on the pump housing to facilitate its removal from the well. If a pump housing should stick in the well, the tubing can be lowered somewhat and elevated again repeatedly to cause the flange 32 to strike sharp blows against the shoulder 33 to jar the pump housing loose from the well wall.

The tubular member 5 is provided with lateral openings 86 which, when the pump is in operative position, are within the upper end of the housing, but which, when the tubular member 5 is lifted to bring the flanges 32 into engagement with the shoulders 33 are positioned above the top of the housing. The openings 86 serve the purpose of draining the liquid from the tubing above a pump, when the tubing is elevated to withdraw the tubing and pump from the well, so that it is necessary to lift only the empty tubing.

It will be apparent that the present invention provides a pumping apparatus for drilled wells which is so constructed as to facilitate the insertion and removal of the apparatus from the well, that the pump is so constructed that there will be a minimum of leakage through the pump and that the pump housing, tubing and rotor are so supported that the tubing and rotor may rotate in the pump housing with a minimum of frictional resistance to turning movement.

It will also be apparent that a pump is provided which is of rugged construction capable of being operated under severe service conditions for a long period of time and which is of high efficiency.

Furthermore, it is to be understood that the particular form of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. A pump comprising a central cylindrical section forming a rotor chamber and externally threaded at its ends and end sections screwed onto said central section, a rotor having a body portion within the central section of the housing and a stepped axial extension at each end, each of which consists of a bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portion, thrust members seated in the end sections and engaging the outer ends of the bearing portions of the rotor, and bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust members and the central housing section.

2. A pump comprising a central cylindrical section forming a rotor chamber and externally threaded at its ends and end sections screwed onto said central section, said end sections being hollow to provide inlet and outlet chambers and having axial openings at the outer ends thereof, said end sections having internal shoulders intermediate the ends thereof, a rotor having a body portion within the central section of the housing and a stepped axial extension at each end, each of which consists of a bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portion, thrust members seated on the internal shoulders of the end sections and engaging the outer ends of the bearing portions of the rotor, bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust members and the central housing section, tubular driving members rotatably mounted in the end openings of the housing and keyed to the rotor extensions, and liquid passages connecting said inlet and outlet chambers with the tubular

driving members and said inlet and outlet chambers with the rotor chamber.

3. A pump comprising a central cylindrical section forming a rotor chamber and externally threaded at its ends and end sections screwed onto said central section, said end sections being hollow to provide inlet and outlet chambers and having axial openings at the outer ends thereof, a rotor having a body portion within the central section of the housing and a stepped axial extension at each end, each of which consists of a bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portion, thrust members seated in the end sections and engaging the outer ends of the bearing portions of the rotor, and bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust members and the central housing section, and a packing interposed between each of said sleeves and the rotor extension journaled therein, tubular driving members rotatably mounted in the end openings of the housing and keyed to the rotor extensions, and liquid passages connecting said inlet and outlet chambers with the tubular driving members, and said inlet and outlet chambers with the rotor chamber.

4. A pump comprising a central cylindrical section forming a rotor chamber and externally threaded at its ends and end sections screwed onto said central section, said end sections being hollow to provide inlet and outlet chambers and having axial openings at the outer ends thereof, said end sections having internal shoulders intermediate the ends thereof, a rotor having a body portion within the central section of the housing and a stepped axial extension at each end, each of which consists of a bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portion, thrust members seated on the internal shoulders of the end sections and engaging the outer ends of the bearing portions of the rotor, bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust members and the central housing section, and a packing interposed between each of said sleeves and the rotor extension journaled therein, tubular driving members rotatably mounted in the end openings of the housing and keyed to the rotor extensions, and liquid passages connecting said inlet and outlet chambers with the tubular driving members, and said inlet and outlet chambers with the rotor chamber.

5. A pump comprising a central cylindrical section forming rotor chamber and externally threaded at its ends and end sections screwed onto said central section, said end sections being hollow to provide inlet and outlet chambers and having axial openings at the outer ends thereof, said end sections having internal shoulders intermediate the ends thereof, a rotor having a body portion within the central section of the housing and a stepped axial extension at each end, each of which consists of a bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portion, thrust members seated on the internal shoulders of the end sections and engaging the outer ends of the bearing portions of the rotor, bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust mem-

bers and the central housing section, tubular driving members slidably and rotatably mounted in the end openings of the housing and each of the rotor extensions, each of said tubular driving members having an outwardly projecting flange at its inner end engageable with the interior of the housing to limit outward movement of the driving member, and liquid passages connecting said inlet and outlet chambers with the tubular driving members and said inlet and outlet chambers with the rotor chamber.

6. A pump comprising a central cylindrical section forming a rotor chamber and end sections secured to said central section, said end sections being hollow to provide inlet and outlet chambers and having internal shoulders intermediate the ends thereof, a rotor having a body portion within said central section of the housing and axial extensions at the ends thereof, each of which consists of an inner bearing portion of less diameter than the body portion of the rotor and an outer end portion of less diameter than the bearing portions, thrust members seated against the internal shoulders of the upper and lower end sections and engaging the outer ends of the bearing portions of the rotor, a thrust bearing interposed between the lower thrust member and the lower end of the downwardly extending bearing portion of the rotor, bearing sleeves fitting within the end sections and around the bearing portions of the rotor, said sleeves being clamped between said thrust members and the central housing section and closing the ends of the rotor chamber, said sleeves having passages formed therein to establish communication between said inlet and outlet chambers and the rotor chamber.

7. A pump comprising an elongated housing of a diameter to enter a bored well, well tubing rotatably and slidably mounted in the upper and lower ends of the housing, the lower tubing having shoulders engageable with interior and exterior shoulders of the housing to limit the longitudinal movement of the housing on the tubing, said shoulders serving to support the tubing from the housing as the housing is being lowered into the well and to support the housing on the tubing when the latter has reached its lowermost position in the well, means operated by the housing upon downward movement thereof on the lower tubing, for anchoring the housing in the well and holding the same against rotation, said upper tubing having shoulders engageable with interior and exterior shoulders of the casing, the latter shoulders permitting limited longitudinal movements of the upper tubing in the housing for jarring the housing to dislodge the same from the well wall to permit removal thereof.

8. A pump comprising an elongated housing of a diameter to enter a bored well, well tubing rotatably and slidably mounted in the upper and lower ends of the housing, the lower tubing having shoulders engageable with interior and exterior shoulders of the housing to limit the longitudinal movement of the housing on the tubing, said shoulders serving to support the tubing from the housing as the housing is being lowered into the well and to support the housing on the tubing when the latter has reached its lowermost position in the well, means operated by the housing upon downward movement thereof on the lower tubing, for anchoring the housing in the well and holding the same against rotation, said upper tubing having shoulders engageable with interior and exterior shoulders of the casing, the latter shoulders permitting limited longitudinal move-

ments of the upper tubing in the housing for jarring the housing to dislodge the same from the well wall to permit removal thereof, said upper tubing having drain openings intermediate the ends thereof which are within the pump housing when the tubing is in its lowermost position and above the housing when the tubing is in its uppermost position, and a pump rotor within the housing keyed to the tubing at the upper and lower ends of the housing.

9. A pump comprising an elongated housing of a diameter to enter a bored well, well tubing rotatably and slidably mounted in the upper and lower ends of the housing, the lower tubing having shoulders engageable with interior and exterior shoulders of the housing to limit the longitudinal movement of the housing on the tubing, said shoulders serving to support the tubing from the housing as the housing is being lowered into the well and to support the housing on the tubing when the latter has reached its lowermost position in the well, means operated by the housing upon downward movement thereof, on the lower tubing, for anchoring the housing in the well and holding the same against rotation, said upper tubing having shoulders engageable with interior and exterior shoulders of the housing, the latter shoulders permitting limited longitudinal movements

of the upper tubing in the housing for jarring the housing to dislodge the same from the well wall to permit removal thereof, a rotor in the housing keyed to the tubing at the upper and lower ends thereof, a thrust bearing within the housing for supporting the rotor, a thrust bearing interposed between the lower shoulder of the lower tubing and the housing for supporting the housing, and a thrust bearing interposed between the upper shoulder of the upper tubing and the housing for supporting the tubing extending upwardly from the upper end of the housing.

10. Pumping apparatus for bored wells comprising a pump housing having an outlet chamber at the upper end thereof and a rotor chamber below the outlet chamber, said rotor chamber having an inlet at its lower end and an outlet into the outlet chamber, a piston rotor in said rotor chamber, tubular shafting coupled to said rotor and journaled in the upper end of said housing, said tubular shafting having a lateral opening to the interior of the outlet chamber whereby liquid may be discharged through said shafting, said opening being adjacent the bottom of the outlet chamber whereby a cushioning body of gas will be trapped in said outlet chamber.

ROBERT DEMING.

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